SIEMENS

September 23, 2014 – Prepared by James Sharp

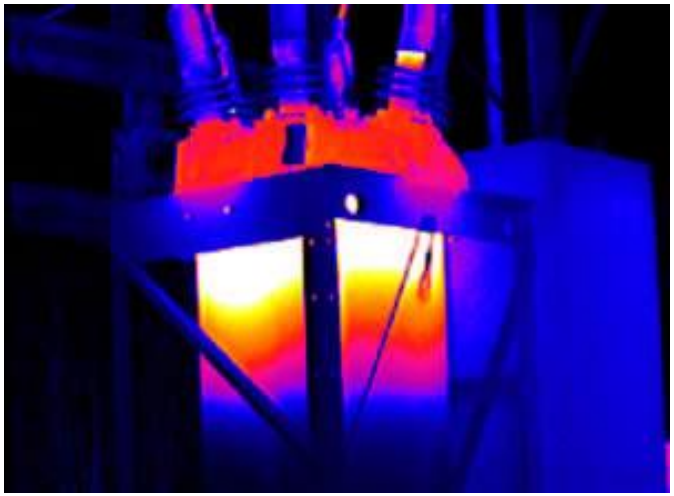
Wireless IR Camera Concept Study

Wireless IR Camera Study - Kickoff

- Assume that Marketing has completed an initial study and determined that there is a need for a predictive equipment monitoring system to be used to protect critical equipment assets.

- The goal is a single system that can monitor a large amount of equipment at the same time as well as equipment of variable design such step up transformers (GSU), auxiliary transformers (UAT), boiler feed pumps (BFP), condensate extraction pumps (CEP), heat recovery steam generators (HRSG) and switch yards.

- Individual vibration monitoring or thermocouple systems for each piece of equipment would be costly, however one or more strategically placed IR cameras may be able to monitor multiple systems at the same time and provide a cost savings over numerous individual monitoring systems



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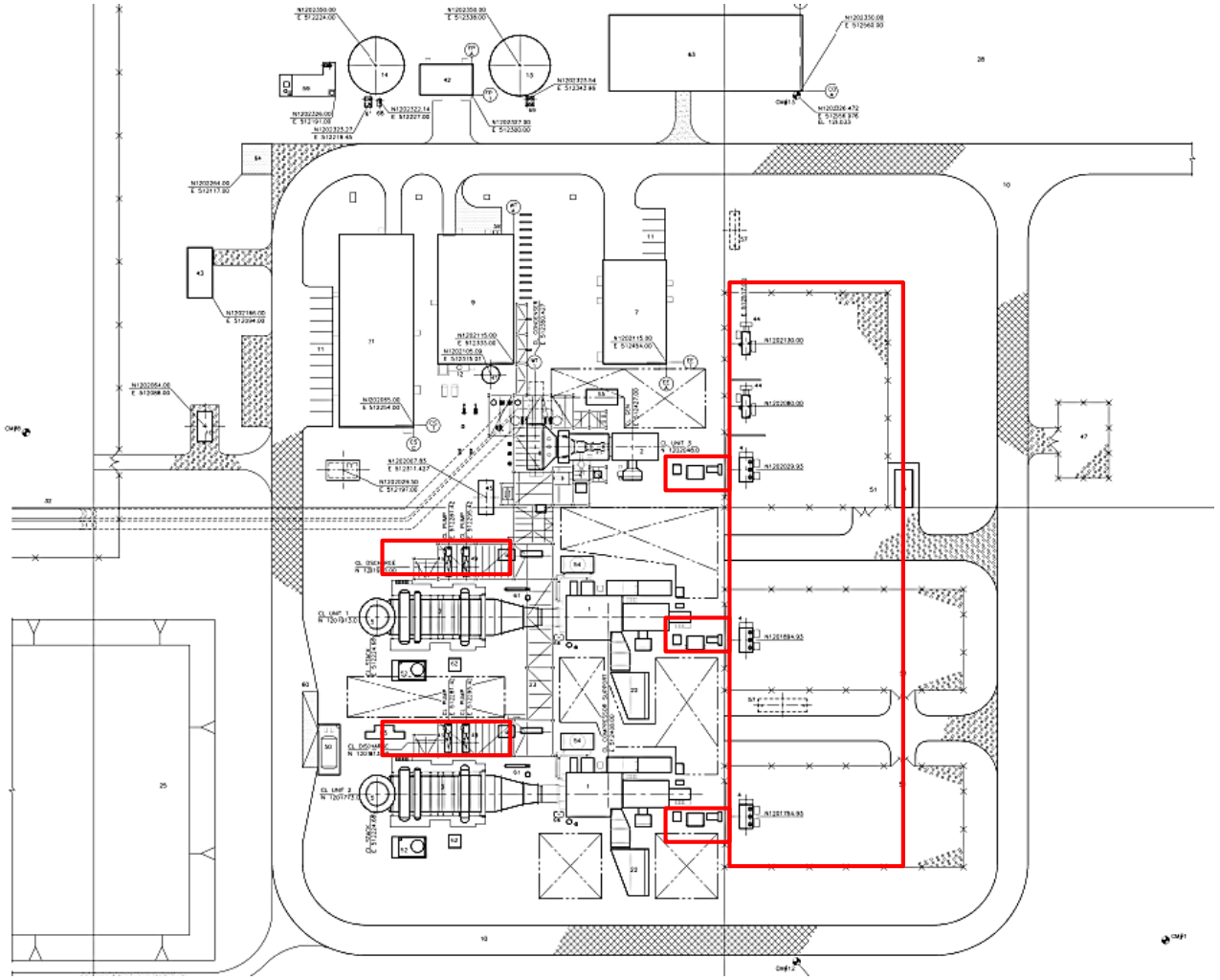
- This drawing is a typical 2 X 1 combined cycle fossil fueled facility
- The device will not be used at nuclear sites
- Areas of site interest for this type of monitoring are shown in red
- The following 2 slides show close ups of the red areas



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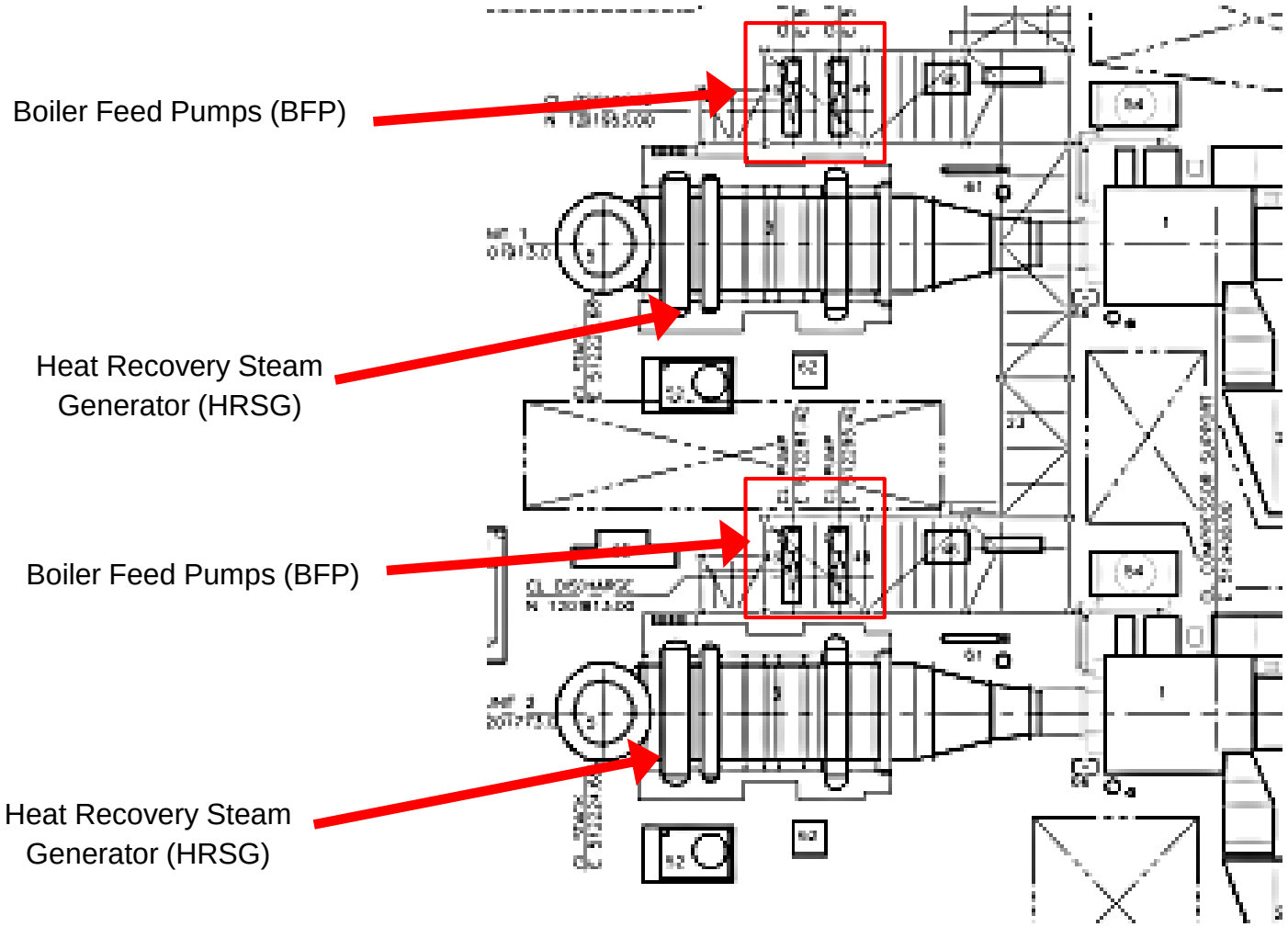

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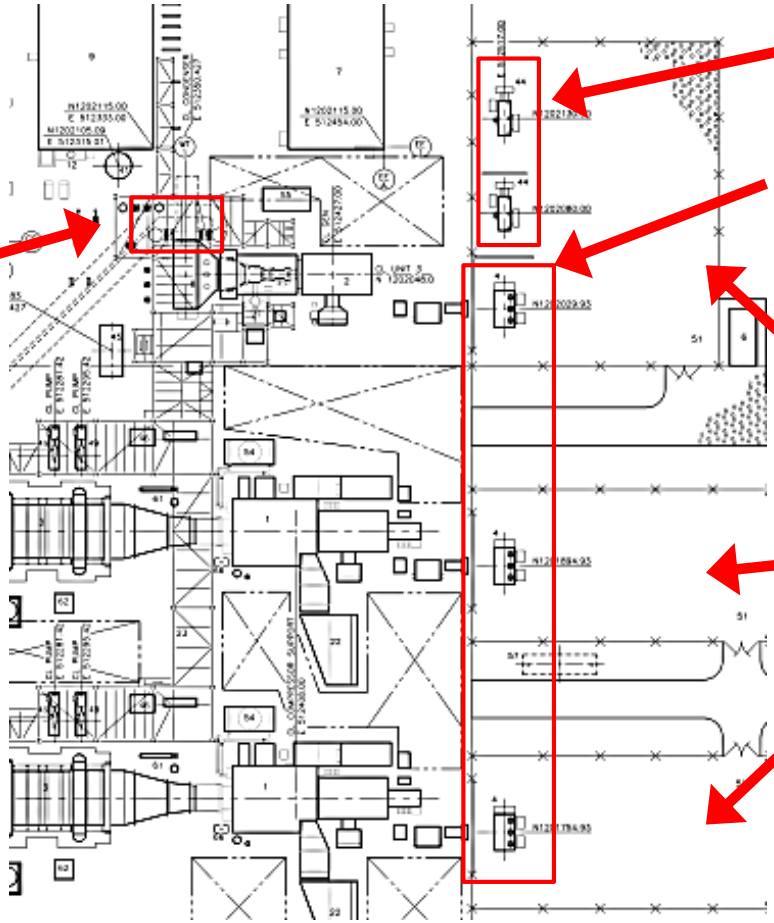

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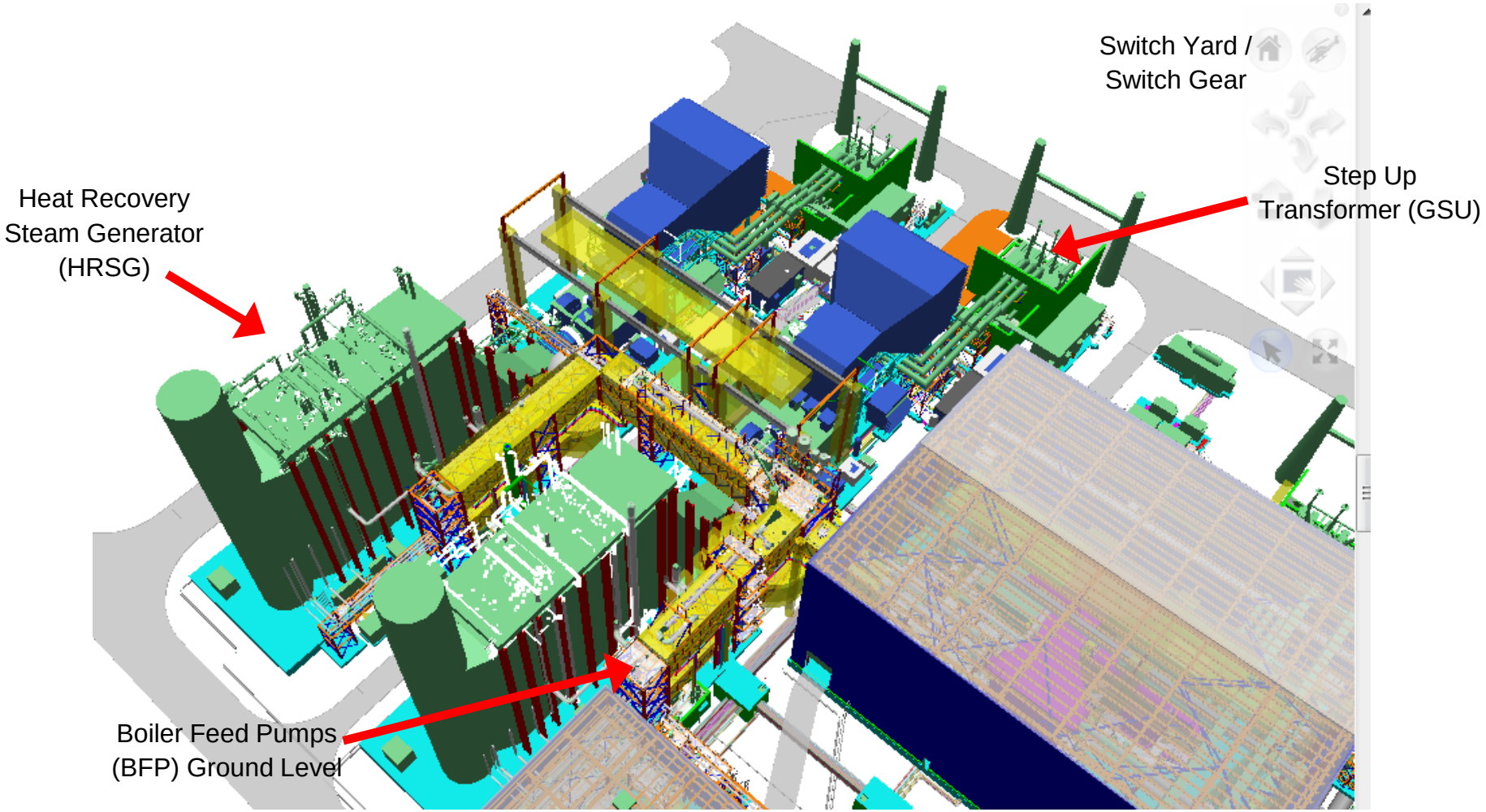

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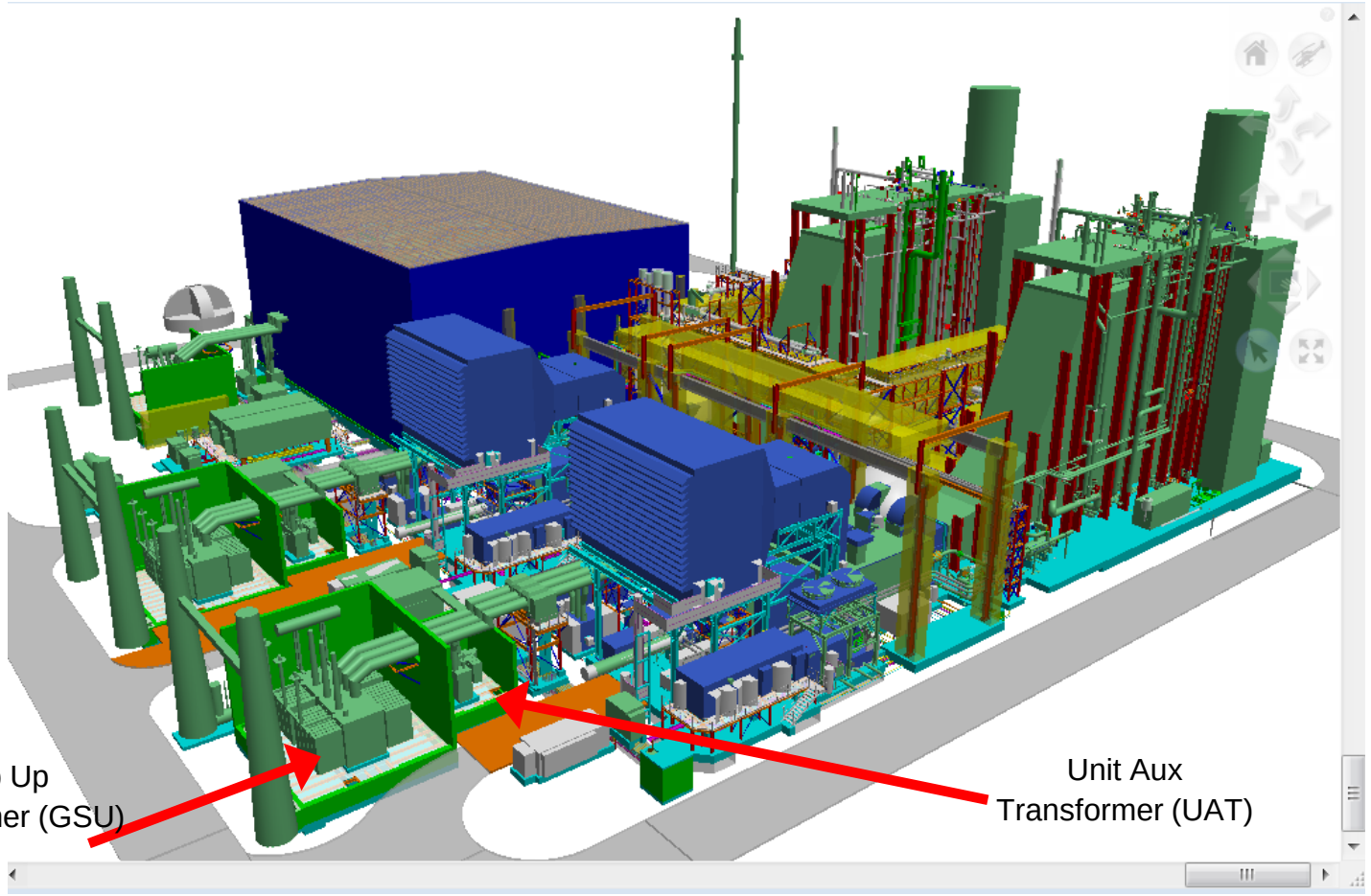

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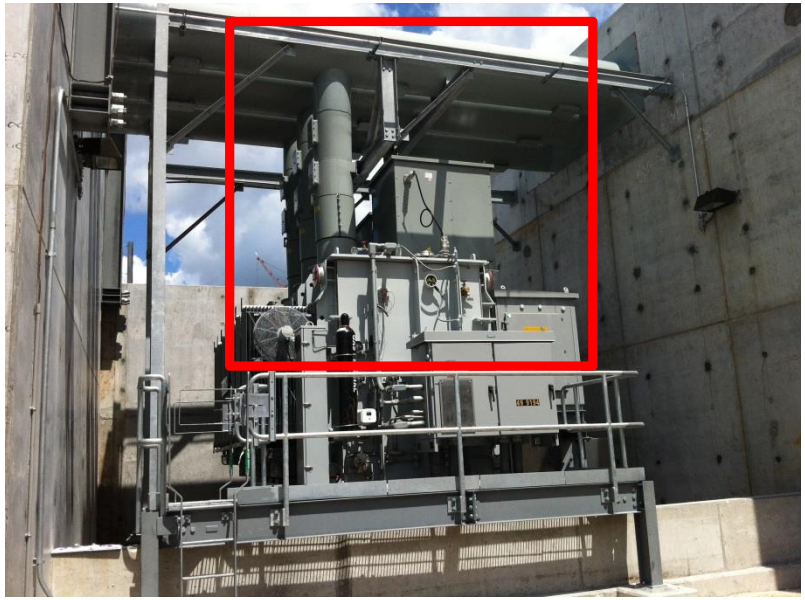
Intended device usages

- GSU and UAT – Monitor three power outlet bushings and top portion of the equipment for hot spots and electrical short circuits indicative of a pre-explosive condition due to loss of insulation

Typical GSU with area of interest in red



Typical UAT with area of interest in red

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Intended device usages

- HRSG and BFP/CEP – Monitor the external casing of the HRSG for hot spots and monitor bearings and motors of BFP/CEP and other pumps for possible burnouts

Typical HRSG – Monitor casing for hot spots

Typical BFP – Monitor for abnormal temps

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Switchyard – Monitor entire yard for abnormal temperatures and electrical shorting

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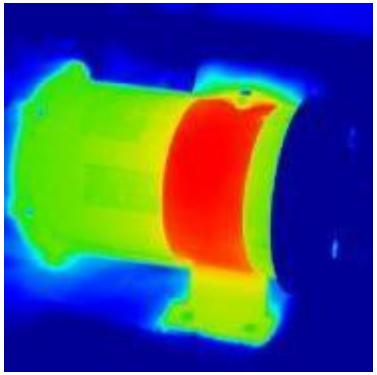
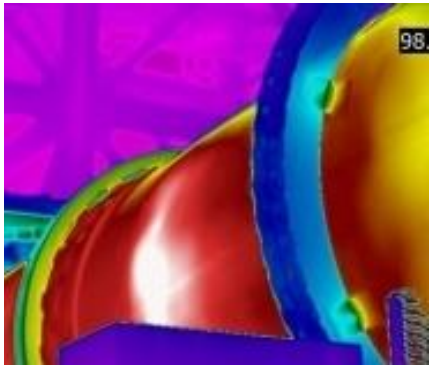
Coupling/ Bearings

PROJECT SPECIFICATION



Motor



Exhaust Transition

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General Notes and Specifications

- Design life of the unit is 30 years
- The unit will be used at conventional fossil fueled (non-nuclear) sites only. The device may also be used at solar or wind power facilities
- The device will be independent of the plant control system. Nevertheless, the team must investigate North American Electric Reliability Corporation (NERC) standards to ensure that the final product is in full compliance with all cyber security requirements. A copy of the NERC standard may be downloaded free of charge at www.nerc.com
- If a site visit is desired or required Siemens will try to arrange such a visit as well as required safety training and personal protection such as hard hats, safety glasses, hearing protection and guidelines on acceptable dress. Siemens will not provide steel toes shoes or transportation costs to and from the site

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Environment:

- The device should be mounted in a central, probably high, outdoor location where it can monitor the largest amount of equipment possible.
- The device must be capable of operating in all environmental conditions including intense and prolonged sunshine, rain, and snow.
- The device must meet the following standard civil engineering criteria - IBC 2006 Code

Seismic Loading (provided for mounting)
Occupancy Category III,
Site Class D,
Mapped Spectral Response S_s = 0.41g, S_1 = 0.19g

Wind Loading
Occupancy Category III,
Basic Wind Speed V_{3s} = 100 mph,
Exposure C

Rainfall
5”/hr for one hour in a 24 hour period.

Ambient Temperature Range
0 F – 110 F

- A weather poof enclosure is acceptable. If the enclosure requires internal heating or cooling the power to operate such a system must come from solar or battery power

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Power Source

Internal Batteries

- The device must function solely on an internal power source such as batteries
- The battery system must be sized so as to be capable of operating the unit for three days on battery power only without recharging
- The batteries should be charged through the use of solar panels, thermal electric generators or any other acceptable power scavenging techniques or a combination of devices
- The batteries must be capable of operating all onboard functions of the device including computer functions, motors, heaters, coolers, 2 way wireless communications or any other device that is needed for full unit operation
- The battery system may be mounted within the weather enclosure of the camera or may be externally mounted with its own enclosure

Charging System

- The device may be installed anywhere within the continental US. If solar power is to be used then a solar insolation chart should be used and referenced in the final proposal to predict the size of the solar cells needed to recharge the device in the shortest time possible while still allowing for a reasonable system cost

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Mounting Functions

- The device should be on a double axis (pan-tilt) rotating motorized mount that allows a 360 degree rotation in the horizontal plane and at least 90 degrees rotation in the vertical plane
    - Primary Goal - The device must be capable of receiving and executing wireless commands from the control room to rotate to any point covered within the rotational range or,
    - Secondary Goal – The device must be capable of being preprogramed automatic rotational pattern without control room guidance and without 2 way communication
- The mount should be reliable and require only minimal maintenance over the life of the unit

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Internal Operations

- The device shall be capable of sending wireless information to a remote laptop in the control room which is operated completely independently of the plant control system. The team must locate a suitable wireless transmitter for this task
    - Primary Goal – (It is recognized that this goal may not be possible due to wireless speeds or power concerns) - transmit streaming video 24/7 from the camera to the laptop which constantly shows the condition of the monitored equipment
    - Secondary goal – Develop an onboard system which can send a photo every five minutes to the control room. The system must be able to recognize any abnormal pixels in the video display, identify the condition as a possible problem, transmit an alarm and a picture of the abnormality to the control room and continue sending updated pictures until such time as the abnormality is corrected or the alarm is manually reset in the control room

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System Deliverables

- Written initial concept to be submitted for approval before substantial work proceeds
- Interim reports every month to be delivered by phone, video conference or brief written report as needed
- Final analysis of all costs associated with the unit including quotes for major equipment, operating costs and estimated maintenance costs over the life of the system as well as substantial evidence that the team has taken economic viability of the device into account
- Complete Microsoft PowerPoint based presentation of final results and also written final report with electronic copy covering all aspects of the effort
- Weather Enclosure - Written specification for the purchase of the device, manufacturer's quote, drawings, and written description of the device features
- Power Source - Written specification for the purchase of the device, manufacturer's quote, drawings, and written description of the device features for both the battery and recharging systems

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System Deliverables

- Mounting System - Written specification for the purchase of the device, manufacturer's quote, drawings, and written description of the device features
- Internal System - Written specification for the purchase of any required equipment, manufacturer's quotes, drawings, written description of the device features including programing
- IR Camera - Written specification for the purchase of the device, manufacturer's quote, drawings, and written description of the device features
- Recommendations for number of units needed and location based upon the 2D and 3D drawings provided in this presentation.
- A prototype is not required but may be provided in full or in part if the schedule and budget allow. If an infrared camera is not available the prototype may use a standard camera instead to demonstrate basic functionality of the system